

CLAIMS

What is claimed is:

1. A tunable optical filter comprising:

a subwavelength resonant grating filter comprising a subwavelength grating having a plurality of diffraction elements, and a planar waveguide layer adjacent and substantially parallel to said subwavelength grating;

a planarized grating layer;

a liquid crystal cell substantially filled with a liquid crystal material, said liquid crystal cell comprising a first surface wall comprised of said planarized subwavelength grating, and a second surface wall;

a surfactant coating applied to said first and second surface walls of said liquid crystal cell; and

means to control of the refractive index of said liquid crystal material, thereby tuning the filter.

2. The tunable optical filter according to claim 1 wherein said subwavelength grating comprises a two dimensional array of nanoscale diffraction elements having subwavelength spacing.

3. The tunable filter according to claim 1 wherein said plurality of diffraction elements exhibit subwavelength periodicity in two orthogonal directions.

4. The tunable optical filter according to claim 3 wherein said plurality of diffraction elements are circular pillars of nanoscale diameter.
5. The tunable optical filter according to claim 1 wherein said first and second surface walls comprise transparent dielectric material.
6. The tunable optical filter according to claim 1 wherein said subwavelength grating and said planar waveguide layer comprise transparent dielectric material and wherein said planar waveguide has a higher index of refraction than said subwavelength grating.
7. The tunable optical filter according to claim 1 wherein said subwavelength grating comprises a linear array of parallel grating lines.
8. The tunable optical filter according to claim 1 wherein said first and second surface walls comprise glass, said electrodes comprise indium tin oxide, said subwavelength grating comprise patterned silicon nitride grating elements and said planar waveguide comprises silicon dioxide.
9. The tunable optical filter according to claim 1 wherein said polymer layer comprises polystyrene.
10. The tunable optical filter according to claim 1 wherein said surfactant coating comprises silicone material.

11. The tunable optical filter according to claim 1 wherein said planar waveguide layer is supported by a substrate layer.

12. The tunable filter of claim 1 wherein the means to control the refractive index of the liquid crystal material comprises a pair of electrodes disposed on opposite sides of said liquid crystal material.

13. The tunable filter of claim 1 wherein the planarized grating layer comprises a grating and a polymer disposed in the grating trenches.

14. A tunable optical filter comprising:

a subwavelength resonant grating optically coupled to a planar waveguide layer, the grating comprising a plurality of grating elements periodically spaced apart in an array and a material filling the spaces between successive grating elements to form a planarized grating surface;

a liquid crystal cell filled with liquid crystal material optically coupled to the planarized grating surface; and

a source of electrical energy coupled to the liquid crystal material to vary the refractive index of the liquid crystal material and thereby tune the optical filter.